

Amendments to the Specification:

Please amend the specification as follows:

Please replace the third paragraph on page 1, with the following rewritten paragraph:

According to such an estimating apparatus, in an internal combustion engine provided with a variable valve mechanism capable of variably controlling closing timing of an exhaust valve, a basic value of a residual gas amount is calculated based on closing timing of the exhaust valve and an engine rotation speed, and if there is no valve overlap, the basic value is estimated as the residual gas amount, while at a valve overlap, the basic value is increasingly corrected based on a period of valve overlap time, a center crank angle position thereof, and a spit-back portion [[at]] during the valve overlap time according to an intake pressure, to estimate the residual gas amount.

Please replace the fifth paragraph starting on page 1, ending on page 2, with the following rewritten paragraph:

Further, even with the same period of valve overlap time and the same center crank angle position thereof, depending on the differences between valve opening areas due to the change in valve lift amount of the intake valve, a spit-back gas amount [[at]] during the valve overlap time is changed (that is, a spit-back portion [[at]] during the valve overlap time cannot be calculated with high accuracy).

Please replace the third paragraph on page 2, with the following rewritten paragraph:

In order to achieve the above objects, a first aspect of the present invention is constituted so that, in an internal combustion engine provided with a variable valve mechanism which varies at least an operating characteristic of an intake valve,

a valve opening area [[at]] during a valve overlap time is calculated based on the valve operating characteristic which is varied by the variable valve mechanism, and

a residual gas amount of the engine is calculated based on the calculated valve opening area and an actual intake air amount of the engine.

Please replace the fourth paragraph on page 2, with the following rewritten paragraph:

Here, the valve opening area $[[at]]$ during the valve overlap time is basically calculated as each of opening areas of intake and exhaust valves based on the valve operating characteristic (opening/closing timing, a valve lift amount and the like), but, for more simplicity, may be calculated as the opening area of the intake valve.

Please replace the sixth paragraph starting on page 2, ending on page 3, with the following rewritten paragraph:

A second aspect of the present invention is constituted so that, in an internal combustion engine provided with a variable valve mechanism, which varies at least an operating characteristic of an intake valve, when performing an intake air amount control mainly by the variable valve mechanism,

a target intake air amount equivalent to a target torque is set based on an operating condition of the engine,

a valve opening area $[[at]]$ during a valve overlap time is calculated based on the valve operating characteristic which is varied by the variable valve mechanism,

a residual gas amount of the engine is calculated based on the valve opening area $[[at]]$ during the valve overlap time and an actual intake air amount of the engine,

a target valve operating characteristic is set based on the target intake air amount and the residual gas amount of the engine, and

the variable valve mechanism is controlled so that the operating characteristic of the intake valve reaches the target valve operating characteristic.

Please replace the second paragraph on page 18, with the following rewritten paragraph:

In the setting of residual gas based correction value KRES in the present embodiment, first a spit-back gas amount W_m due to valve overlap is calculated based on a valve opening

area A_{Wm} $[[at]]$ during a valve overlap time. On the other hand, a residual gas amount W_{cyl} in a state of no valve overlap is calculated based on an actual engine intake air amount.

Please replace the fifth paragraph on page 18, with the following rewritten paragraph:

In Fig. 15, at d10 part, a map previously set is referred to, based on opening timing IVO of intake valve 105 and operating angle VCS-ANGL (valve lift amount) of VEL 112, to calculate valve opening area A_{Wm} $[[at]]$ during the valve overlap time.

Please replace the sixth paragraph on page 18, with the following rewritten paragraph:

Namely, in the present embodiment, since the operating characteristic of exhaust valve 107 is constant, valve opening area A_{Wm} $[[at]]$ during the valve overlap time can be preliminarily obtained based on the valve lift amount and opening timing IVO of intake valve 105.

Please replace the seventh paragraph on page 18, with the following rewritten paragraph:

Here, valve opening area A_{Wm} is obtained as the total valve opening area of intake valve 105 and exhaust valve 107 $[[at]]$ during the valve overlap time. However, for more simplicity, instead of this total valve opening area, only the valve opening area of intake valve 105 having a large influence on the spit-back may be calculated.

Please replace the eighth paragraph on page 18, with the following rewritten paragraph:

At d11 part, a table T_{Wm} previously set is retrieved based on calculated valve opening area A_{Wm} , to calculate a basic spit-back gas amount W_{m0} $[[at]]$ during the valve overlap time. This basic spit-back gas amount W_{m0} is obtained in advance as a spit-back gas amount according to a valve opening area in a predetermined reference condition (for example, $N_e=1200\text{rpm}$, $P_m=13.3\text{KPa}$).

Please replace the seventh paragraph starting on page 19, ending on page 20 with the following rewritten paragraph:

To be specific, cylinder residual gas amount W_{cyl0} is multiplied by a rotation speed based correction value KHOSNEE calculated based on engine rotation speed N_e at d23 part, to be set as a basic residual gas amount W_{cyl} . The reason why such a correction is executed is that, as well as the spit-back W_{m0} during the overlap time, the residual gas is influenced by engine rotation speed N_e . Note, since it has been verified by the experiment that the residual gas amount is decreased as engine rotation speed N_e is higher, rotation speed based correction value KHOSNEE is set based on this experimental result, in this embodiment (refer to Fig. 17).

Please replace the fourth paragraph on page 20, with the following rewritten paragraph:

As described in the above, in the present embodiment, spit-back gas amount W_m W_{m0} during the valve overlap time is calculated, based on the total valve opening area of intake valve 105 and exhaust valve 107 (or based on the valve opening area of intake valve 105 only). Thus, considering the (total) valve opening area A_{vo} during the valve overlap time, the spit-back gas amount W_{m0} during the valve overlap time can be obtained with high accuracy, in the internal combustion engine provided with VEL 112 which variably controls the valve lift amount.

Please replace the third paragraph on page 28, with the following rewritten paragraph:

In Fig. 23, at S1 part, by referring to a map based on opening timing IVO of intake valve 105 and operating angle VCS-ANGL of VEL 112, spit-back residual gas rate (basic spit-back residual gas rate) W_{m0} (%) in the reference condition W_{m0} during the valve overlap time (refer to the description of d11 part of Fig. 15) is calculated.

Please replace the third paragraph on page 31, with the following rewritten paragraph:

In this embodiment, as in the first embodiment (Fig. 15), spit-back gas amount W_m W_{m0} during the valve overlap time and cylinder residual gas amount W_{cyl} are calculated, and the resultants are added together, to be set as total residual gas amount W . Then, residual gas

rate $RES (=W/(Qa+W))$ is calculated, and a table is retrieved based on this residual gas rate RES , to calculate residual gas based correction value $KRES$.

Please replace the sixth paragraph on page 33, with the following rewritten paragraph:

In this embodiment, in the same manner as in the first embodiment (Fig. 15) and the second embodiment (Fig. 27), spit-back gas amount Wm [[at]] during the valve overlap time and cylinder residual gas amount W_{cyl} are calculated, and the calculation resultants are added together to be set as total residual gas amount W . Then, residual gas rate $RES (=W/(Qa+W))$ is calculated, and a table is retrieved based on this residual gas rate RES to set residual gas based correction value $KRES$.

Please replace the second paragraph on page 34, with the following rewritten paragraph:

In Fig. 29, at d50 part, a map previously set is referred to, based on opening timing IVO of intake valve 105 and operating angle $VCS-ANGL$ (valve lift amount) of VEL 112, to calculate valve opening area AWm [[at]] during the valve overlap time.

Please replace the fourth paragraph on page 34, with the following rewritten paragraph:

At d51 part, table TWm previously set is retrieved based on calculated valve opening area AWm , to calculate basic spit-back gas amount $Wm0$ [[at]] during the valve overlap time.

Please replace the eighth paragraph on page 34, with the following rewritten paragraph:

Further, in a constitution shown in Fig. 29, a plurality of tables each converting valve opening area AWm into basic spit-back gas amount $Wm0$ [[at]] during the valve overlap time is set for each closing timing EVC of exhaust valve 107, to obtain basic spit-back gas amount $Wm0$ corresponding to a change in closing timing EVC of exhaust valve 107. Instead, for example, as shown in Fig. 30, the estimation corresponding to closing timing EVC of exhaust valve 107 can be executed.

Please replace the first paragraph on page 35, with the following rewritten paragraph:

In an example shown in Fig. 30, at d51 part, valve opening area A_{Wm} is converted into basic spit-back gas amount W_{m0} ~~[[at]]~~ during the valve overlap time using one table T_{Wm} , while setting a correction value $HOSRESE$ according to closing timing EVC of exhaust valve 107 at d51-1 part and adding correction value $HOSRESE$ to basic spit-back gas amount W_{m0} , so that a correction corresponding to the change in closing timing EVC of exhaust valve 107 is executed on basic spit-back gas amount W_{m0} .